A METHOD AND SYSTEM FOR CONTROLLING ACCESS IN DETAIL-IN-CONTEXT PRESENTATIONS

[0001] This application claims priority from Canadian Patent Application No. 2,411,898, filed November 15, 2002, the disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] This invention relates to the field of computer graphics processing, and more specifically, to a method and system for controlling user access to secured (e.g. detailed) information in a detail-in-context presentation using detail-in-context lenses and a detail-in-context graphical user interface ("GUI").

BACKGROUND OF THE INVENTION

[0003] Traditionally, information security in data processing systems has been addressed at the operating system, network, and application or file levels. Application level security and security for data which may be controlled under an application (i.e., so-called "fine grain labelling" at the level of a file or specific information such as a sentence, paragraph or particular numerical data within a file) is typically implemented in a manner that is unique to the application.

[0004] Several methods have been proposed for securing information at the application or file level. For example, United States Patent No. 5,991,877 to Luckenbaugh discloses an object-oriented trusted application framework that allows for fine grain labelling. As another example, United States Patent No. 5,848,231 to Teitelbaum, et al., discloses a method for configuring and reconfiguring a computer system based on user authorization wherein users may perceive that they have unlimited access to computer system resources. In one embodiment, in a computer system that includes a GUI, available files are displayed and unavailable files are not such that the unauthorized user is limited to the available files. Through this configuration, the unauthorized user is provided with an interface that suggests that the unavailable files do not exist. However, neither the method of Teitelbaum, et al., nor the framework of Luckenbaugh allows users to effectively contextualize information that is available from that which is not.

[0005] To elaborate, a disadvantage of existing methods for securing application level information is that they do not provide a user-friendly indication to users of what information is secured within the context of a larger body of unsecured information. For example, in computer graphics applications which process large graphical image files such as digital maps, it is often important for a user to contextualize the image being presented on a system display screen. That is, while a user may use well-known "panning" and "zooming" tools to view a desired area or object in a large image at an unsecured level, in doing so, the relative location of the corresponding area or object at a detailed and secured level may be lost to the user or the user may find it difficult to determine what portion of the image is being observed. An additional disadvantage of existing methods is that they do not allow for the effective control of access by users to secured detailed information within the context of surrounding unsecured information. These disadvantages are examples of what is often referred to as the "screen real estate problem".

[0006] A need therefore exists for an improved method and system for controlling user access to secured (e.g. detailed or confidential) information within the context of surrounding information. Consequently, it is an object of the present invention to obviate or mitigate at least some of the above mentioned disadvantages.

SUMMARY OF THE INVENTION

[0007] According to one aspect of the invention, there is provided a method for controlling access to secured information for a predetermined region of a computer generated original image presented on a display, comprising: determining whether a user is authorized to access the secured information; and, in response to the determining, distorting the original image to produce a distorted region for the predetermined region to provide the user with the secured information on the display.

[0008] Preferably, the method further includes, in response to the step of determining, uncovering the distorted region.

[0009] Preferably, the step of determining further includes receiving authentication information from the user and comparing the authentication information to stored authentication information for the user.

[0010] Preferably, the authentication information includes a user identification number and a password.

[0011] Preferably, the authentication information is received through a dialog box.

[0012] Preferably, the dialog box is presented adjacent to the predetermined region.

[0013] Preferably, the method further includes the step of receiving a signal from the user to select the predetermined region.

[0014] Preferably, the signal is generated by moving a cursor on the display with a pointing device.

[0015] Preferably, the pointing device is a mouse.

[0016] Preferably, the secured information is detailed information.

[0017] Preferably, the detailed information is a magnified image.

[0018] Preferably, the secured information is encrypted information.

[0019] Preferably, the step of distorting further comprises decrypting the encrypted information.

[0020] Preferably, the original image includes a graphic image, a photographic image, and a text image.

[0021] Preferably, the step of distorting further includes: creating a lens surface for the distorted region; and, transforming the original image by applying a distortion function defining the lens surface to the original image.

[0022] Preferably, the step of creating further includes displaying a GUI over the distorted region for adjusting the lens surface.

[0023] Preferably, the lens surface includes a focal region and a base and the GUI includes: a slide bar icon for adjusting a magnification for the lens surface; a slide bar icon for adjusting a degree of scooping for the lens surface; a bounding rectangle icon with at least one handle icon for adjusting a size and a shape for the focal region; a bounding rectangle icon with at least one handle icon for adjusting a size and a shape for the base; a move icon for adjusting a location for the lens surface within the original image; a pickup icon for adjusting a location for the base within the original image; and, a fold icon for adjusting a location for the focal region relative to the base.

[0024] Preferably, the authentication information is biometric information including fingerprint, iris pattern, voice pattern, and DNA pattern information.

[0025] According to another aspect of the invention, there is provided a method for accessing detailed information for a predetermined region of a computer generated original image presented on a display, comprising: determining whether a user is authorized to access the detailed information; and, in response to the determining, distorting the original image to produce a distorted region for the predetermined region to provide the user with the detailed information on the display.

[0026] Advantageously, while the user access control element provided by the present invention prevents unauthorized viewing of secured information in a lens image, it allows a user to view unsecured information in a surrounding base image. Thus, the context of the secured information within the unsecured information is maintained for the user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Embodiments of the invention may best be understood by referring to the following description and accompanying drawings. In the description and drawings, like numerals refer to like structures or processes. In the drawings:

[0028] FIG. 1 is a graphical representation of the geometry for constructing a three-dimensional perspective viewing frustum, relative to an x, y, z coordinate system, in accordance with known elastic presentation space graphics technology;

[0029] FIG. 2 is a graphical representation of the geometry of a presentation in accordance with known elastic presentation space graphics technology;

[0030] FIG. 3 is a block diagram illustrating a data processing system adapted for implementing an embodiment of the invention;

[0031] FIG. 4 a partial screen capture illustrating a GUI having lens control elements for user interaction with detail-in-context data presentations in accordance with an embodiment of the invention;

[0032] FIG. 5 is a screen capture illustrating an original digital image or representation of an airport in accordance with an embodiment of the invention;

[0033] FIG. 6 is a screen capture illustrating a presentation having a detail-in-context lens and an associated GUI for the original digital image of FIG. 5 in accordance with an embodiment of the invention;

[0034] FIG. 7 is a screen capture illustrating the effect of a user access control element on a detail-in-context presentation for an original image in accordance with an embodiment of the invention;

[0035] FIG. 8 is a block diagram illustrating user access control element functionality in accordance with an embodiment of the invention; and,

[0036] FIG. 9 is a flow chart illustrating a method for controlling access to detailed information for a predetermined region of a computer generated original image presented on a display in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0037] In the following description, numerous specific details are set forth to provide a thorough understanding of the invention. However, it is understood that the invention may be practiced without these specific details. In other instances, well-known software, circuits, structures and techniques have not been described or shown in detail in order not to obscure the invention. The

term "data processing system" is used herein to refer to any machine for processing data, including the computer systems and network arrangements described herein.

[0038] The "screen real estate problem" mentioned above generally arises whenever large amounts of information are to be displayed on a display screen of limited size. Known tools to address this problem include panning and zooming. While these tools are suitable for a large number of visual display applications, they become less effective where sections of the visual information are spatially related, such as in layered maps and three-dimensional representations, for example. In this type of information display, panning and zooming are not as effective as much of the context of the panned or zoomed display may be hidden.

[0039] A recent solution to this problem is the application of "detail-in-context" presentation techniques. Detail-in-context is the magnification of a particular region-of-interest (the "focal region" or "detail") in a data presentation while preserving visibility of the surrounding information (the "context"). This technique has applicability to the display of large surface area media (e.g. digital maps) on computer screens of variable size including graphics workstations, laptop computers, personal digital assistants ("PDAs"), and cell phones.

[0040] In the detail-in-context discourse, differentiation is often made between the terms "representation" and "presentation". A representation is a formal system, or mapping, for specifying raw information or data that is stored in a computer or data processing system. For example, a digital map of a city is a representation of raw data including street names and the relative geographic location of streets and utilities. Such a representation may be displayed visually on a computer screen or printed on paper. On the other hand, a presentation is a spatial organization of a given representation that is appropriate for the task at hand. Thus, a presentation of a representation organizes such things as the point of view and the relative emphasis of different parts or regions of the representation. For example, a digital map of a city may be presented with a region magnified to reveal street names.

[0041] In general, a detail-in-context presentation may be considered as a distorted view (or distortion) of a portion of the original representation or image where the distortion is the result of the application of a "lens" like distortion function to the original representation. A detailed review of various detail-in-context presentation techniques such as "Elastic Presentation Space"

("EPS") (or "Pliable Display Technology" ("PDT")) may be found in a publication by Marianne S. T. Carpendale, entitled "A Framework for Elastic Presentation Space" (Carpendale, Marianne S. T., *A Framework for Elastic Presentation Space* (Burnaby, British Columbia: Simon Fraser University, 1999)), and incorporated herein by reference.

[0042] In general, detail-in-context data presentations are characterized by magnification of areas of an image where detail is desired, in combination with compression of a restricted range of areas of the remaining information (i.e. the context), the result typically giving the appearance of a lens having been applied to the display surface. Using the techniques described by Carpendale, points in a representation are displaced in three dimensions and a perspective projection is used to display the points on a two-dimensional presentation display. Thus, when a lens is applied to a two-dimensional continuous surface representation, for example, the resulting presentation appears to be three-dimensional. In other words, the lens transformation appears to have stretched the continuous surface in a third dimension. In EPS graphics technology, a two-dimensional visual representation is placed onto a surface; this surface is placed in three-dimensional space; the surface, containing the representation, is viewed through perspective projection; and the surface is manipulated to effect the reorganization of image details. The presentation transformation is separated into two steps: surface manipulation or distortion and perspective projection.

[0043] FIG. 1 is a graphical representation **100** of the geometry for constructing a three-dimensional ("3D") perspective viewing frustum **220**, relative to an x, y, z coordinate system, in accordance with known elastic presentation space (EPS) graphics technology. In EPS technology, detail-in-context views of two-dimensional ("2D") visual representations are created with sight-line aligned distortions of a 2D information presentation surface within a 3D perspective viewing frustum **220**. In EPS, magnification of regions of interest and the accompanying compression of the contextual region to accommodate this change in scale are produced by the movement of regions of the surface towards the viewpoint ("VP") **240** located at the apex of the pyramidal shape **220** containing the frustum. The process of projecting these transformed layouts via a perspective projection results in a new 2D layout which includes the zoomed and compressed regions. The use of the third dimension and perspective distortion to provide magnification in EPS provides a meaningful metaphor for the process of distorting the

information presentation surface. The 3D manipulation of the information presentation surface in such a system is an intermediate step in the process of creating a new 2D layout of the information.

[0044] FIG. 2 is a graphical representation **200** of the geometry of a presentation in accordance with known EPS graphics technology. EPS graphics technology employs viewer-aligned perspective projections to produce detail-in-context presentations in a reference view plane **201** which may be viewed on a display. Undistorted 2D data points are located in a basal plane **210** of a 3D perspective viewing volume or frustum **220** which is defined by extreme rays **221** and **222** and the basal plane **210**. The VP **240** is generally located above the centre point of the basal plane **210** and reference view plane ("RVP") **201**. Points in the basal plane **210** are displaced upward onto a distorted surface **230** which is defined by a general 3D distortion function (i.e. a detail-in-context distortion basis function). The direction of the viewer-aligned perspective projection corresponding to the distorted surface **230** is indicated by the line FPo - FP **231** drawn from a point FPo **232** in the basal plane **210** through the point FP **233** which corresponds to the focus or focal region or focal point of the distorted surface **230**.

[0045] EPS is applicable to multidimensional data and is well suited to implementation on a computer for dynamic detail-in-context display on an electronic display surface such as a monitor. In the case of two dimensional data, EPS is typically characterized by magnification of areas of an image where detail is desired **233**, in combination with compression of a restricted range of areas of the remaining information (i.e. the context) **234**, the end result typically giving the appearance of a lens **230** having been applied to the display surface. The areas of the lens **230** where compression occurs may be referred to as the "shoulder" **234** of the lens **230**. The area of the representation transformed by the lens may be referred to as the "lensed area". The lensed area thus includes the focal region and the shoulder. To reiterate, the source image or representation to be viewed is located in the basal plane **210**. Magnification **233** and compression **234** are achieved through elevating elements of the source image relative to the basal plane **210**, and then projecting the resultant distorted surface onto the reference view plane **201**. EPS performs detail-in-context presentation of n-dimensional data through the use of a procedure wherein the data is mapped into a region in an (n+1) dimensional space, manipulated through perspective projections in the (n+1) dimensional space, and then finally transformed back into n-

dimensional space for presentation. EPS has numerous advantages over conventional zoom, pan, and scroll technologies, including the capability of preserving the visibility of information outside **234** the local region of interest **233**.

[0046] For example, and referring to FIGS. 1 and 2, in two dimensions, EPS can be implemented through the projection of an image onto a reference plane **201** in the following manner. The source image or representation is located on a basal plane **210**, and those regions of interest **233** of the image for which magnification is desired are elevated so as to move them closer to a reference plane situated between the reference viewpoint **240** and the reference view plane **201**. Magnification of the focal region **233** closest to the RVP **201** varies inversely with distance from the RVP **201**. As shown in FIGS. 1 and 2, compression of regions **234** outside the focal region **233** is a function of both distance from the RVP **201**, and the gradient of the function describing the vertical distance from the RVP **201** with respect to horizontal distance from the focal region **233**. The resultant combination of magnification **233** and compression **234** of the image as seen from the reference viewpoint **240** results in a lens-like effect similar to that of a magnifying glass applied to the image. Hence, the various functions used to vary the magnification and compression of the source image via vertical displacement from the basal plane **210** are described as lenses, lens types, or lens functions. Lens functions that describe basic lens types with point and circular focal regions, as well as certain more complex lenses and advanced capabilities such as folding, have previously been described by Carpendale.

[0047] *System.* FIG. 3 is a block diagram of a data processing system **300** adapted to implement an embodiment of the invention. The data processing system **300** is suitable for implementing EPS technology, for displaying detail-in-context presentations of representations, and for controlling user access to secured information in conjunction with a detail-in-context graphical user interface (GUI) **400**, as described below. The data processing system **300** includes an input device **310**, a central processing unit ("CPU") **320**, memory **330**, and a display **340**. The input device **310** may include a keyboard, mouse, trackball, or similar device. The CPU **320** may include dedicated coprocessors and memory devices. The memory **330** may include RAM, ROM, databases, or disk devices. And, the display **340** may include a computer screen, terminal device, or a hardcopy producing output device such as a printer or plotter. The data processing system **300** has stored therein data representing sequences of instructions which when executed

cause the method described herein to be performed. Of course, the data processing system **300** may contain additional software and hardware a description of which is not necessary for understanding the invention.

[0048] *GUI with Lens Control Elements.* As mentioned, detail-in-context presentations of data using techniques such as pliable surfaces, as described by Carpendale, are useful in presenting large amounts of information on limited-size display surfaces. Detail-in-context views allow magnification of a particular region-of-interest (the "focal region") **233** in a data presentation while preserving visibility of the surrounding information **210**. In the following, a GUI **400** is described having lens control elements that can be implemented in software and applied to the editing of multi-layer images and to the control of detail-in-context data presentations. The software can be loaded into and run by the data processing system **300** of FIG. 3.

[0049] FIG. 4 is a partial screen capture illustrating a GUI **400** having lens control elements for user interaction with detail-in-context data presentations in accordance with an embodiment of the invention. Detail-in-context data presentations are characterized by magnification of areas of an image where detail is desired, in combination with compression of a restricted range of areas of the remaining information (i.e. the context), the end result typically giving the appearance of a lens having been applied to the display screen surface. This lens **410** includes a "focal region" **420** having high magnification, a surrounding "shoulder region" **430** where information is typically visibly compressed, and a "base" **412** surrounding the shoulder region **430** and defining the extent of the lens **410**. In FIG. 4, the lens **410** is shown with a circular shaped base **412** (or outline) and with a focal region **420** lying near the center of the lens **410**. However, the lens **410** and focal region **420** may have any desired shape. For example, in FIG. 6, the lens **610** has a conical frustum shape with a flat top **620** and conical shoulders **630**. As mentioned above, the base of the lens **412**, **612** may be coextensive with the focal region **420, 620**.

[0050] In general, the GUI **400** has lens control elements that, in combination, provide for the interactive control of the lens **410, 610**. The effective control of the characteristics of the lens **410** by a user (i.e. dynamic interaction with a detail-in-context lens) is advantageous. At any given time, one or more of these lens control elements may be made visible to the user on the display surface **340** by appearing as overlay icons on the lens **410**. Interaction with each element

is performed via the motion of an input or pointing device **310** (e.g. mouse), with the motion resulting in an appropriate change in the corresponding lens characteristic. As will be described, selection of which lens control element is actively controlled by the motion of the pointing device **310** at any given time is determined by the proximity of the icon representing the pointing device **310** (e.g. cursor) on the display surface **340** to the appropriate component of the lens **410**. For example, "dragging" of the pointing device at the periphery of the bounding rectangle of the lens base **412** causes a corresponding change in the size of the lens **410** (i.e. "resizing"). Thus, the GUI **400** provides the user with a visual representation of which lens control element is being adjusted through the display of one or more corresponding icons.

[0051] For ease of understanding, the following discussion will be in the context of using a two-dimensional pointing device **310** that is a mouse, but it will be understood that the invention may be practiced with other 2D or 3D (or even greater numbers of dimensions) pointing devices including a trackball and keyboard.

[0052] A mouse **310** controls the position of a cursor icon **401** that is displayed on the display screen **340**. The cursor **401** is moved by moving the mouse **310** over a flat surface, such as the top of a desk, in the desired direction of movement of the cursor **401**. Thus, the two-dimensional movement of the mouse **310** on the flat surface translates into a corresponding two-dimensional movement of the cursor **401** on the display screen **340**.

[0053] A mouse **310** typically has one or more finger actuated control buttons (i.e. mouse buttons). While the mouse buttons can be used for different functions such as selecting a menu option pointed at by the cursor **401**, the disclosed invention may use a single mouse button to "select" a lens **410** and to trace the movement of the cursor **401** along a desired path. Specifically, to select a lens **410**, the cursor **401** is first located within the extent of the lens **410**. In other words, the cursor **401** is "pointed" at the lens **410**. Next, the mouse button is depressed and released. That is, the mouse button is "clicked". Selection is thus a point and click operation. To trace the movement of the cursor **401**, the cursor **401** is located at the desired starting location, the mouse button is depressed to signal the computer **320** to activate a lens control element, and the mouse **310** is moved while maintaining the button depressed. After the desired path has been traced, the mouse button is released. This procedure is often referred to as

"clicking" and "dragging" (i.e. a click and drag operation). It will be understood that a predetermined key on a keyboard **310** could also be used to activate a mouse click or drag. In the following, the term "clicking" will refer to the depression of a mouse button indicating a selection by the user and the term "dragging" will refer to the subsequent motion of the mouse **310** and cursor **401** without the release of the mouse button.

[0054] The GUI **400** may include the following lens control elements: move, pickup, resize base, resize focus, fold, magnify, zoom, and scoop. Each of these lens control elements has at least one lens control icon or alternate cursor icon associated with it. In general, when a lens **410** is selected by a user through a point and click operation, the following lens control icons may be displayed over the lens **410**: pickup icon **450**, base outline icon **412**, base bounding rectangle icon **411**, focal region bounding rectangle icon **421**, handle icons **481**, **482**, **491**, magnify slide bar icon **440**, zoom icon **495**, and scoop slide bar icon **640** (see FIG. 6). Typically, these icons are displayed simultaneously after selection of the lens **410**. In addition, when the cursor **401** is located within the extent of a selected lens **410**, an alternate cursor icon **460**, **470**, **480**, **490**, **495** may be displayed over the lens **410** to replace the cursor **401** or may be displayed in combination with the cursor **401**. These lens control elements, corresponding icons, and their effects on the characteristics of a lens **410** are described below with reference to FIG. 4.

[0055] In general, when a lens **410** is selected by a point and click operation, bounding rectangle icons **411**, **421** are displayed surrounding the base **412** and focal region **420** of the selected lens **410** to indicate that the lens **410** has been selected. With respect to the bounding rectangles **411**, **421** one might view them as glass windows enclosing the lens base **412** and focal region **420**, respectively. The bounding rectangles **411**, **421** include handle icons **481**, **482**, **491** allowing for direct manipulation of the enclosed base **412** and focal region **420** as will be explained below. Thus, the bounding rectangles **411**, **421** not only inform the user that the lens **410** has been selected, but also provide the user with indications as to what manipulation operations might be possible for the selected lens **410** though use of the displayed handles **481**, **482**, **491**. Note that it is well within the scope of the present invention to provide a bounding region having a shape other than generally rectangular. Such a bounding region could be of any of a great number of shapes including oblong, oval, ovoid, conical, cubic, cylindrical, polyhedral, spherical, etc.

[0056] Moreover, the cursor **401** provides a visual cue indicating the nature of an available lens control element. As such, the cursor **401** will generally change in form by simply pointing to a different lens control icon **450, 412, 411, 421, 481, 482, 491, 440, 640**. For example, when resizing the base **412** of a lens **410** using a corner handle **491**, the cursor **401** will change form to a resize icon **490** once it is pointed at (i.e. positioned over) the corner handle **491**. The cursor **401** will remain in the form of the resize icon **490** until the cursor **401** has been moved away from the corner handle **491**.

[0057] *Move*. Lateral movement of a lens **410** is provided by the move lens control element of the GUI **400**. This functionality is accomplished by the user first selecting the lens **410, 610** through a point and click operation. Then, the user points to a point within the lens **410** that is other than a point lying on a lens control icon **450, 412, 411, 421, 481, 482, 491, 440, 640**. When the cursor **401** is so located, a move icon **460** is displayed over the lens **410** to replace the cursor **401** or may be displayed in combination with the cursor **401**. The move icon **460** not only informs the user that the lens **410** may be moved, but also provides the user with indications as to what movement operations are possible for the selected lens **410**. For example, the move icon **460** may include arrowheads indicating up, down, left, and right motion. Next, the lens **410** is moved by a click and drag operation in which the user clicks and drags the lens **410** to the desired position on the screen **340** and then releases the mouse button **310**. The lens **410** is locked in its new position until a further pickup and move operation is performed.

[0058] *Pickup*. Lateral movement of a lens **410** is also provided by the pickup lens control element of the GUI. This functionality is accomplished by the user first selecting the lens **410** through a point and click operation. As mentioned above, when the lens **410** is selected a pickup icon **450** is displayed over the lens **410** near the centre of the lens **410**. Typically, the pickup icon **450** will be a crosshairs. In addition, a base outline **412** is displayed over the lens **410** representing the base **412** of the lens **410**. The crosshairs **450** and lens outline **412** not only inform the user that the lens has been selected, but also provides the user with an indication as to the pickup operation that is possible for the selected lens **410**. Next, the user points at the crosshairs **450** with the cursor **401**. Then, the lens outline **412** is moved by a click and drag operation in which the user clicks and drags the crosshairs **450** to the desired position on the screen **340** and then releases the mouse button **310**. The full lens **410** is then moved to the new

position and is locked there until a further pickup operation is performed. In contrast to the move operation described above, with the pickup operation, it is the outline **412** of the lens **410** that the user repositions rather than the full lens **410**.

[0059] *Resize Base.* Resizing of the base **412** (or outline) of a lens **410** is provided by the resize base lens control element of the GUI. After the lens **410** is selected, a bounding rectangle icon **411** is displayed surrounding the base **412**. For a rectangular shaped base **412**, the bounding rectangle icon **411** may be coextensive with the perimeter of the base **412**. The bounding rectangle **411** includes handles **491**. These handles **491** can be used to stretch the base **412** taller or shorter, wider or narrower, or proportionally larger or smaller. The corner handles **491** will keep the proportions the same while changing the size. The middle handles (not shown) will make the base **412** taller or shorter, wider or narrower. Resizing the base **412** by the corner handles **491** will keep the base **412** in proportion. Resizing the base **412** by the middle handles (not shown) will change the proportions of the base **412**. That is, the middle handles (not shown) change the aspect ratio of the base **412** (i.e. the ratio between the height and the width of the bounding rectangle **411** of the base **412**). When a user points at a handle **491** with the cursor **401** a resize icon **490** may be displayed over the handle **491** to replace the cursor **401** or may be displayed in combination with the cursor **401**. The resize icon **490** not only informs the user that the handle **491** may be selected, but also provides the user with indications as to the resizing operations that are possible with the selected handle. For example, the resize icon **490** for a corner handle **491** may include arrows indicating proportional resizing. The resize icon (not shown) for a middle handle (not shown) may include arrows indicating width resizing or height resizing. After pointing at the desired handle **491**, the user would click and drag the handle **491** until the desired shape and size for the base **412** is reached. Once the desired shape and size are reached, the user would release the mouse button **310**. The base **412** of the lens **410** is then locked in its new size and shape until a further base resize operation is performed.

[0060] *Resize Focus.* Resizing of the focal region **420** of a lens **410** is provided by the resize focus lens control element of the GUI. After the lens **410** is selected, a bounding rectangle icon **421** is displayed surrounding the focal region **420**. For a rectangular shaped focal region **420**, the bounding rectangle icon **421** may be coextensive with the perimeter of the focal region **420**. The bounding rectangle **421** includes handles **481**, **482**. These handles **481**, **482** can be used to stretch

the focal region **420** taller or shorter, wider or narrower, or proportionally larger or smaller. The corner handles **481** will keep the proportions the same while changing the size. The middle handles **482** will make the focal region **420** taller or shorter, wider or narrower. Resizing the focal region **420** by the corner handles **481** will keep the focal region **420** in proportion. Resizing the focal region **420** by the middle handles **482** will change the proportions of the focal region **420**. That is, the middle handles **482** change the aspect ratio of the focal region **420** (i.e. the ratio between the height and the width of the bounding rectangle **421** of the focal region **420**). When a user points at a handle **481**, **482** with the cursor **401** a resize icon **480** may be displayed over the handle **481**, **482** to replace the cursor **401** or may be displayed in combination with the cursor **401**. The resize icon **480** not only informs the user that a handle **481**, **482** may be selected, but also provides the user with indications as to the resizing operations that are possible with the selected handle. For example, the resize icon **480** for a corner handle **481** may include arrows indicating proportional resizing. The resize icon **480** for a middle handle **482** may include arrows indicating width resizing or height resizing. After pointing at the desired handle **481**, **482**, the user would click and drag the handle **481**, **482** until the desired shape and size for the focal region **420** is reached. Once the desired shape and size are reached, the user would release the mouse button **310**. The focal region **420** is then locked in its new size and shape until a further focus resize operation is performed.

[0061] *Fold.* Folding of the focal region **420** of a lens **410** is provided by the fold control element of the GUI. In general, control of the degree and direction of folding (i.e. skewing of the viewer aligned vector **231** as described by Carpendale) is accomplished by a click and drag operation on a point **471**, other than a handle **481**, **482**, on the bounding rectangle **421** surrounding the focal region **420**. The direction of folding is determined by the direction in which the point **471** is dragged. The degree of folding is determined by the magnitude of the translation of the cursor **401** during the drag. In general, the direction and degree of folding corresponds to the relative displacement of the focus **420** with respect to the lens base **410**. In other words, and referring to FIG. 2, the direction and degree of folding corresponds to the displacement of the point FP **233** relative to the point FPo **232**, where the vector joining the points FPo **232** and FP **233** defines the viewer aligned vector **231**. In particular, after the lens **410** is selected, a bounding rectangle icon **421** is displayed surrounding the focal region **420**. The bounding rectangle **421** includes handles **481**, **482**. When a user points at a point **471**, other than

a handle **481**, **482**, on the bounding rectangle **421** surrounding the focal region **420** with the cursor **401**, a fold icon **470** may be displayed over the point **471** to replace the cursor **401** or may be displayed in combination with the cursor **401**. The fold icon **470** not only informs the user that a point **471** on the bounding rectangle **421** may be selected, but also provides the user with indications as to what fold operations are possible. For example, the fold icon **470** may include arrowheads indicating up, down, left, and right motion. By choosing a point **471**, other than a handle **481**, **482**, on the bounding rectangle **421** a user may control the degree and direction of folding. To control the direction of folding, the user would click on the point **471** and drag in the desired direction of folding. To control the degree of folding, the user would drag to a greater or lesser degree in the desired direction of folding. Once the desired direction and degree of folding is reached, the user would release the mouse button **310**. The lens **410** is then locked with the selected fold until a further fold operation is performed.

[0062] *Magnify*. Magnification of the lens **410** is provided by the magnify lens control element of the GUI. After the lens **410** is selected, the magnify control is presented to the user as a slide bar icon **440** near or adjacent to the lens **410** and typically to one side of the lens **410**. Sliding the bar **441** of the slide bar **440** results in a proportional change in the magnification of the lens **410**. The slide bar **440** not only informs the user that magnification of the lens **410** may be selected, but also provides the user with an indication as to what level of magnification is possible. The slide bar **440** includes a bar **441** that may be slid up and down, or left and right, to adjust and indicate the level of magnification. To control the level of magnification, the user would click on the bar **441** of the slide bar **440** and drag in the direction of desired magnification level. Once the desired level of magnification is reached, the user would release the mouse button **310**. The lens **410** is then locked with the selected magnification until a further magnification operation is performed. In general, the focal region **420** is an area of the lens **410** having constant magnification (i.e. if the focal region is a plane). Again referring to FIGS. 1 and 2, magnification of the focal region **420**, **233** varies inversely with the distance from the focal region **420**, **233** to the reference view plane (RVP) **201**. Magnification of areas lying in the shoulder region **430** of the lens **410** also varies inversely with their distance from the RVP **201**. Thus, magnification of areas lying in the shoulder region **430** will range from unity at the base **412** to the level of magnification of the focal region **420**.

[0063] *Zoom*. Zoom functionality is provided by the zoom lens control element of the GUI. Referring to FIG. 2, the zoom lens control element, for example, allows a user to quickly navigate to a region of interest **233** within a continuous view of a larger presentation **210** and then zoom in to that region of interest **233** for detailed viewing or editing. Referring to FIG. 4, the combined presentation area covered by the focal region **420** and shoulder region **430** and surrounded by the base **412** may be referred to as the "extent of the lens". Similarly, the presentation area covered by the focal region **420** may be referred to as the "extent of the focal region". The extent of the lens may be indicated to a user by a base bounding rectangle **411** when the lens **410** is selected. The extent of the lens may also be indicated by an arbitrarily shaped figure that bounds or is coincident with the perimeter of the base **412**. Similarly, the extent of the focal region may be indicated by a second bounding rectangle **421** or arbitrarily shaped figure. The zoom lens control element allows a user to: (a) "zoom in" to the extent of the focal region such that the extent of the focal region fills the display screen **340** (i.e. "zoom to focal region extent"); (b) "zoom in" to the extent of the lens such that the extent of the lens fills the display screen **340** (i.e. "zoom to lens extent"); or, (c) "zoom in" to the area lying outside of the extent of the focal region such that the area without the focal region is magnified to the same level as the extent of the focal region (i.e. "zoom to scale").

[0064] In particular, after the lens **410** is selected, a bounding rectangle icon **411** is displayed surrounding the base **412** and a bounding rectangle icon **421** is displayed surrounding the focal region **420**. Zoom functionality is accomplished by the user first selecting the zoom icon **495** through a point and click operation When a user selects zoom functionality, a zoom cursor icon **496** may be displayed to replace the cursor **401** or may be displayed in combination with the cursor **401**. The zoom cursor icon **496** provides the user with indications as to what zoom operations are possible. For example, the zoom cursor icon **496** may include a magnifying glass. By choosing a point within the extent of the focal region, within the extent of the lens, or without the extent of the lens, the user may control the zoom function. To zoom in to the extent of the focal region such that the extent of the focal region fills the display screen **340** (i.e. "zoom to focal region extent"), the user would point and click within the extent of the focal region. To zoom in to the extent of the lens such that the extent of the lens fills the display screen **340** (i.e. "zoom to lens extent"), the user would point and click within the extent of the lens. Or, to zoom in to the presentation area without the extent of the focal region, such that the area without the

extent of the focal region is magnified to the same level as the extent of the focal region (i.e. "zoom to scale"), the user would point and click without the extent of the lens. After the point and click operation is complete, the presentation is locked with the selected zoom until a further zoom operation is performed.

[0065] Alternatively, rather than choosing a point within the extent of the focal region, within the extent of the lens, or without the extent of the lens to select the zoom function, a zoom function menu with multiple items (not shown) or multiple zoom function icons (not shown) may be used for zoom function selection. The zoom function menu may be presented as a pull-down menu. The zoom function icons may be presented in a toolbar **650** or adjacent to the lens **410** when the lens is selected. Individual zoom function menu items or zoom function icons may be provided for each of the "zoom to focal region extent", "zoom to lens extent", and "zoom to scale" functions described above. In this alternative, after the lens **410** is selected, a bounding rectangle icon **411** may be displayed surrounding the base **412** and a bounding rectangle icon 421 may be displayed surrounding the focal region **420**. Zoom functionality is accomplished by the user selecting a zoom function from the zoom function menu or via the zoom function icons using a point and click operation. In this way, a zoom function may be selected without considering the position of the cursor **401** within the lens **410**.

[0066] *Scoop.* The concavity or "scoop" of the shoulder region **430** of the lens **410** is provided by the scoop lens control element of the GUI. After the lens **410** is selected, the scoop control is presented to the user as a slide bar icon **640** (see FIG. 6) near or adjacent to the lens **410, 610** and typically below the lens **410**. Sliding the bar **641** of the slide bar **640** results in a proportional change in the concavity or scoop of the shoulder region **430** of the lens **410**. The slide bar **640** not only informs the user that the shape of the shoulder region **430** of the lens **410** may be selected, but also provides the user with an indication as to what degree of shaping is possible. The slide bar **640** includes a bar **641** that may be slid left and right, or up and down, to adjust and indicate the degree of scooping. To control the degree of scooping, the user would click on the bar **641** of the slide bar **640** and drag in the direction of desired scooping degree. Once the desired degree of scooping is reached, the user would release the mouse button **310**. The lens **410** is then locked with the selected scoop until a further scooping operation is performed.

[0067] *Icon Hiding.* Advantageously, a user may choose to hide one or more lens control icons **450, 412, 411, 421, 481, 482, 491, 440, 495, 640** shown in FIGS. 4 and 6 from view so as not to impede the user's view of the image within the lens **410**. This may be helpful, for example, during an editing or move operation. A user may select this option through means such as a menu, toolbar, or lens property dialog box.

[0068] *Redo and Undo.* In addition, the GUI **400** maintains a record of control element operations such that the user may restore pre-operation presentations. This record of operations may be accessed by or presented to the user through "Undo" and "Redo" icons **497, 498** , through a pull-down operation history menu (not shown), or through a toolbar.

[0069] *Controlling Access to Secured Information Using Detail-In-Context Lenses.* Detail-in-context data viewing techniques allow a user to view multiple levels of detail or resolution on one display **340**. The appearance of the data display or presentation is that of one or more virtual lenses showing detail **233** within the context of a larger area view **210**. Using multiple lenses in detail-in-context data presentations may be used to compare two regions of interest at the same time. Folding enhances this comparison by allowing the user to pull the regions of interest closer together. Moreover, using detail-in-context technology such as PDT, an area of interest can be magnified to pixel level resolution, or to any level of detail available from the source information, for in-depth review. In accordance with the present invention, detail-in-context lenses may be used to control user access to secured, confidential or otherwise protected information in digital images. The digital images may include graphic images, maps, photographic images, or text documents, and the source information may be in raster, vector, or text form.

[0070] FIG. 5 is a screen capture illustrating an original digital image or representation **500** in accordance with an embodiment of the invention. In FIG. 5, the original image **500** includes an airport **510**. The original image **500** may also include secured (e.g. confidential) and unsecured (e.g. non-confidential) information. As will be described below, a user may only access or view secured information pertaining to the original image **500** if the user has the appropriate level of authorization. The secured information may include, for example, a detailed or magnified view of the airport **510** within the original image **500**.

[0071] FIG. 6 is a screen capture illustrating a presentation **600** having a detail-in-context lens **410** and an associated GUI **400** for the original digital image **500** of FIG. 5 in accordance with an embodiment of the invention. In order to view a selected object or area in detail, such as an airplane **520** on the airport's runway, a user defines a lens **410** over the object **520** using the GUI **400**. The lens **410** may be introduced to the original image **500** to form the illustrated presentation **600** through the use of a pull-down menu selection, tool bar icon, etc. Using lens control elements for the GUI **400**, such as move, pickup, resize base, resize focus, fold, magnify, zoom, and scoop, as described above, the user adjusts the lens **410** for detailed viewing of the object **520** or area. Using the magnify lens control element, for example, the user may magnify the focal region **420** of the lens **410** to pixel quality resolution revealing detailed information pertaining to selected object **520** or area. That is, a base image (i.e., the image outside the extent of the lens) is displayed at a low resolution while a lens image (i.e., the image within the extent of the lens) is displayed at a resolution based on a user selected magnification **440, 441**.

[0072] In FIG. 6, the base image **670** (i.e., that portion of presentation **600** outside the extent of the lens **410**) shows a portion of the airport **510** and original image **500** at low resolution. The lens image **680** (i.e., that portion of the presentation **600** within the extent of the lens **410** and including the focal **420** and shoulder **430** regions of the lens **410**) shows a portion of the airport **510** at high resolution thus revealing detailed information pertaining to the airplane **520** located on the airport's runway. Thus, the presentation **600** allows a user to view portions **670, 680** of the original image **500** simultaneously and in context.

[0073] In operation, the data processing system **300** employs EPS techniques with an input device **310** and GUI **400** for selecting objects **520** or areas for detailed display to a user on a display screen **340**. Data representing an original image or representation is received by the CPU **320** of the data processing system **300**. Using EPS techniques, the CPU **320** processes the data in accordance with instructions received from the user via an input device **310** and GUI **400** to produce a detail-in-context presentation **600**. The presentation **600** is presented to the user on a display screen **340**. It will be understood that the CPU **320** may apply a transformation to the shoulder region **430** surrounding the region-of-interest **420** to affect blending or folding in accordance with EPS technology. For example, the transformation may map the region-of-interest **420** and/or shoulder region **430** to a predefined lens surface, defined by a transformation

or distortion function and having a variety of shapes, using EPS techniques. Or, the lens **410** may be simply coextensive with the region-of-interest **420**. (Blending and folding of lenses in detail-in-context presentations are described in United States Patent Application Publication No. 2002/0044154 which is incorporated herein by reference.)

[0074] The lens control elements of the GUI **400** are adjusted by the user via an input device **310** to control the characteristics of the lens **410** in the detail-in-context presentation **600**. Using an input device **310** such as a mouse, a user adjusts parameters of the lens **410** using icons and scroll bars of the GUI **400** that are displayed over the lens **410** on the display screen **340**. The user may also adjust parameters of the image of the full scene. Signals representing input device **310** movements and selections are transmitted to the CPU **320** of the data processing system **300** where they are translated into instructions for lens control.

[0075] Moreover, the lens **410** may be added to the presentation **600** before or after the object **520** or area is selected. That is, the user may first add a lens **410** to a presentation **600** or the user may move a pre-existing lens into place over the selected object **520** or area. The lens **410** may be introduced to the original image to form the presentation **600** through the use of a pull-down menu selection, tool bar icon, etc.

[0076] Advantageously, by using a detail-in-context lens **410** to select an object **520** or area for detailed information gathering, a user can view a large area **670** (i.e., outside the extent of the lens **410**) while focusing in on a smaller area **680** (or within the focal region **420** of the lens **410**) surrounding the selected object **520**. This makes it possible for a user to accurately gather detailed information without losing visibility or context of the portion of the original image surrounding the selected object **520**.

[0077] Now, according to an embodiment of the present invention, the GUI **400** also includes a user access control element. FIG. 7 is a screen capture illustrating the effect of the user access control element on a detail-in-context presentation **700** for an original image **500** in accordance with an embodiment of the invention. The user access control element causes the lens image **680** of the presentation **700** be occluded by an access denied icon **750** when the user does not have authorization to view detailed information made available in the lens image **680**. The access

denied icon **750** may occlude the entire lens image **680** or a portion of the lens image **680** such as the focal region **420**.

[0078] To determine if a user is authorized to view the lens image **680**, the user access control element may include an associated user access pop-up dialog window or box (not shown) which may be displayed over or adjacent to the lens **410**. The user access dialog box requests that the user enter a user identification number ("ID") and a password, or similar credentials, to determine if the user is authorized to view the lens image **680**. The user ID and password are checked or authenticated against a database or table stored in the memory **330** of the data processing system **300**. If the user ID and password are valid or authentic, the access denied icon **750** is removed and the user is allowed to view the lens image **680**. Alternatively, the user access control element may have an associated toolbar or pull-down menu to effect user authentication.

[0079] FIG. 8 is a block diagram **800** illustrating user access control element functionality in accordance with an embodiment of the invention. Given an original image **500** having secured information, the original image **500** being stored in the memory **330** of the data processing system **300** or other document repository, if a user has authorized access **810** to the secured information, then the user is allowed to view the secured information in the lens image **680** of a detail-in-context presentation **600**. However, if the user does not have authorized access **820** to the secured information, then the lens image **680** is occluded by an access denied icon **750** in the detail-in-context presentation **700**.

[0080] The present invention allows for the control of information displayed in the lens image **680** independent from the information displayed in the surrounding base image **670**. In this way, when it is desired that access to the lens image **680** be secured or restricted, the user access control element may be activated and the control of user access my be effected by means of a user access dialog box. User access to the lens image **680** may be secured, for example, when the detailed information revealed by the lens image **680** pertains to confidential, politically sensitive, or militarily sensitive subject matter. In these circumstances, the user access control element prevents unauthorized viewing of the detailed information in the lens image **680**. Advantageously, while the user access control element prevents unauthorized viewing of secured information in the lens image **680**, it allows a user to view unsecured information in the

surrounding base image **670**. Thus, the context of the secured information within the unsecured information is maintained for the user.

[0081] According to one embodiment of the invention, the original image **500** is encrypted and the user access control element includes means to decrypt the lens image **680** for presentation to the user. The decryption means may be incorporated in the user access dialog box.

[0082] According to one embodiment of the invention, the input device **310** of the data processing system **300** may include a biometric information input device (e.g., scanner, digitizer, etc.) for receiving biometric information or credentials to authenticate the user in conjunction with the user access control element. The biometric information may include fingerprint, iris pattern, voice pattern, or DNA pattern information for identifying the user. The input of biometric information may be requested by the user access dialog box.

[0083] According to one embodiment of the invention, if it is desired to prevent a user from viewing predetermined areas of the original image **500** at a magnified level, the lens **410** may be prevented from being positioned over those predetermined areas. Alternatively, the lens **410** may be otherwise prevented from displaying data for those predetermined areas. For example, when the lens **410** is positioned over a predetermined secure area, the magnify lens control element **440**, **441** may be inhibited thus preventing the user from viewing the secure area in detail. This embodiment of the invention may be used, for example, in an Internet commerce application in situations where it is desired to let the user inspect part of an image in detail while preventing the user from downloading the entirety of the image without purchasing the rights to do so.

[0084] *Method.* FIG. 9 is a flow chart **900** illustrating a method for controlling access to secured information for a predetermined region **411**, **412** of a computer generated original image **500** presented on a display **340** in accordance with an embodiment of the invention. At step **901**, the method starts.

[0085] At step **902**, whether a user is authorized to access the secured information is determined.

[0086] Preferably, the method further includes, in response to the step of determining **902**, uncovering **750** the distorted region **680**. Preferably, the step of determining **902** further includes receiving authentication information from the user and comparing the authentication information

to stored authentication information for the user. Preferably, the authentication information includes a user identification number and a password. Preferably, the authentication information is received through a dialog box. Preferably, the dialog box is presented adjacent to the predetermined region **412** (or **411**). Preferably, the method further includes the step of receiving a signal from the user to select the predetermined region **412** (or **411**). Preferably, the signal is generated by moving a cursor **410** on the display **340** with a pointing device **310**. Preferably, the pointing device **310** is a mouse. Preferably, the original image **500** includes a graphic image, a photographic image, and a text image. Preferably, the authentication information is biometric information including fingerprint, iris pattern, voice pattern, and DNA pattern information.

[0087] At step **903**, in response to this determination **902**, the original image **500** is distorted to produce a distorted region **680** for the predetermined region **412** (or **411**) to provide the user with the secured information on the display **340**.

[0088] Preferably, the secured information is detailed information. Preferably, the detailed information is a magnified image (**440, 441**). Preferably, the secured information is encrypted information. Preferably, the step of distorting **903** further comprises decrypting the encrypted information. Preferably, the step of distorting **903** further includes: creating a lens surface **410** for the distorted region **680**; and, transforming the original image **500** by applying a distortion function defining the lens surface **410** to the original image **500**. Preferably, the step of creating further includes displaying a GUI **400** over the distorted region **680** for adjusting the lens surface **410**. Preferably, the lens surface **410** includes a focal region **420** and a base **412** and the GUI **400** includes: a slide bar icon **440, 441** for adjusting a magnification for the lens surface **410**; a slide bar icon **640, 641** for adjusting a degree of scooping for the lens surface **410**; a bounding rectangle icon **421** with at least one handle icon **481, 482** for adjusting a size and a shape for the focal region **420**; a bounding rectangle icon **411** with at least one handle icon **491** for adjusting a size and a shape for the base **412**; a move icon **460** for adjusting a location for the lens surface **410** within the original image **500**; a pickup icon **450** for adjusting a location for the base **412** within the original image **500**; and, a fold icon **470** for adjusting a location for the focal region **420** relative to the base **412**.

[0089] At step **904**, the method ends.

[0090] *Data Carrier Product.* The sequences of instructions which when executed cause the method described herein to be performed by the exemplary data processing system of FIG. 3 can be contained in a data carrier product according to one embodiment of the invention. This data carrier product can be loaded into and run by the exemplary data processing system of FIG. 3.

[0091] *Computer Software Product.* The sequences of instructions which when executed cause the method described herein to be performed by the exemplary data processing system of FIG. 3 can be contained in a computer software product according to one embodiment of the invention. This computer software product can be loaded into and run by the exemplary data processing system of FIG. 3.

[0092] *Integrated Circuit Product.* The sequences of instructions which when executed cause the method described herein to be performed by the exemplary data processing system of FIG. 3 can be contained in an integrated circuit product including a coprocessor or memory according to one embodiment of the invention. This integrated circuit product can be installed in the exemplary data processing system of FIG. 3.

[0093] Although preferred embodiments of the invention have been described herein, it will be understood by those skilled in the art that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.